## COAL TARS AND COAL TAR PITCHES*

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## CARCINOGENICITY

Coal tars and coal tar pitches are *known to be human carcinogens* based on sufficient evidence of carcinogenicity in humans (IARC 1985, 1987). There have been a number of case reports of skin cancer in patients who used tar ointments for a variety of skin diseases. A mortality analysis in the United Kingdom from 1946 showed a greatly increased scrotal cancer risk for patent-fuel workers. Furthermore, a large number of case reports describe the development of skin (including the scrotum) cancer in workers exposed to coal tars or coal-tar pitches. Several epidemiological studies have shown an excess of lung cancer among workers exposed to coal tar fumes in coal gasification and coke production. A cohort study of U.S. roofers indicated an increased risk for cancer of the lung and suggested increased risks for cancers of the oral cavity, larynx, esophagus, stomach, skin, and bladder, and for leukemia. Some support for excess risks of lung, laryngeal, and oral cavity cancer is provided by other studies of roofers. Several epidemiological studies have shown excesses of lung and urinary bladder cancer among workers exposed to pitch fumes in aluminum production plants. A slight excess of lung cancer was found among furnace and maintenance workers exposed to coal tar pitch fumes in a calcium carbide production plant. One study showed a small excess of bladder cancer in tar distillers and in patent-fuel workers. An elevated risk of cancer of the renal pelvis was observed in workers exposed to "petroleum or tar or pitch". One study of millwrights and welders exposed to coal tars and coal tar pitch in a stamping plant showed significant excesses of leukemia and of cancers of the lung and digestive organs (IARC 1987).

When administered topically to experimental animals, coal tars (CAS No. 8007-45-2), coal tar extracts, and high-temperature coal tars (CAS No. 65996-89-6) induced skin papillomas and carcinomas (IARC 1985). Pharmaceutical coal tars and tar ointments caused skin papillomas, squamous cell carcinomas, and/or carcinomas when applied to the skin of mice of both sexes. When applied to the skin, coal tar induced epidermoid lung carcinomas in rats, and when applied to the ears of rabbits, coal tar caused skin papillomas. When administered intramuscularly, coal tar fume condensate induced injection site sarcomas in mice of both sexes. Analyses of coal tars indicate the presence of a number of known carcinogens and potentially carcinogenic chemicals which are discussed elsewhere in this document, including benz[*a*]anthracene, benzo[*b*]fluoranthene, benzo[*j*]fluoranthene, benzo[*k*]fluoranthene, benzo[*a*]pyrene, dibenz[*a,h*]anthracene, dibenzo[*a,i*]pyrene, and indeno[1,2,3-*cd*]pyrene (see Polycyclic Aromatic Hydrocarbons, 15 listings).

When administered topically or by whole-body exposure, coal tar pitch, a coal tar distillate, induced skin papillomas and carcinomas in mice. When applied topically, coal tar pitch extracts induced skin papillomas and carcinomas in mice; these extracts also had both initiating and promoting activities (in separate studies) in mouse skin. In one study, an extract of a hard residue from a coke oven tar induced lung tumors, but no skin tumors, in mice (IARC 1974). Analyses of coal tar pitches reveal the presence of several carcinogenic polycyclic aromatic hydrocarbons (IARC 1985).

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* No separate CAS registry number is assigned to tars.

## PROPERTIES

Coal tars are by-products of the destructive distillation (carbonization) of coal to produce coke and/or gas. The composition and properties of a coal tar depend primarily on the temperature of the carbonization, and to a lesser extent, on the nature (source) of the coal used as feedstock. They are typically viscous liquids or semisolids that are black or almost black in color and have a characteristic naphthalene-like odor (ATSDR 1996). Coal tars are slightly soluble in water, soluble in benzene and nitrobenzene, and partially soluble in acetone, carbon disulfide, chloroform, diethyl ether, ethanol, methanol, petroleum ether, and sodium hydroxide. In general, coal tars are complex combinations of hydrocarbons, phenols, heterocyclic oxygen, sulfur, and nitrogen compounds. Over 400 compounds have been identified in coal tars and as many as 10,000 may actually be present. The content of polycyclic aromatic hydrocarbons in coal tars increases as the carbonization temperature increases. Low-temperature coal tars (<700°C) are black, viscous liquids that are denser than water and contain a lower percentage (40% to 50%) of aromatic compounds than high-temperature coal tars (>700°C) (IARC 1985). Coal tars are highly flammable and corrosive and toxic gases may be released from fires. The vapors can form explosive mixtures with air (HSDB 2001).

Coal tar pitch is a shiny, dark brown to black residue produced during the distillation of coal tars. Pitch contains various polycyclic aromatic hydrocarbons, their methyl and polymethyl derivatives, and heteronuclear compounds (IARC 1985).

## USE

Coal tar is primarily used for the production of refined chemicals and coal tar products such as creosote, coal tar pitch, and crude naphthalene and anthracene oils from the distillation of crude coal tar. It is also used as a fuel in open-hearth furnaces and blast furnaces in the steel industry. Coal tar is suitable as a fuel because of its availability, its low sulfur content, and its high heating value. Both high-temperature and low-temperature coal tars are used to treat psoriasis and other chronic skin diseases. Coal tar products are also used in numerous pharmaceutical products including creams, ointments, pastes, lotions, bath and body oils, shampoos, soaps, and gels. The coal tar products present in these formulations include coal tars (0.18% to 10%), coal tar solution (2% to 48.5%), coal tar extract (5%), tar distillate (3% to 25%), coal tar fraction (1.25%), and acetyl alcohol coal tar (4%). Coal tar extract is also used in neomycin sulfate-hydrocortisone ointment. USP-grade coal tar is approved for use in denatured alcohol. Coal tar is also used as a binder and filler in surface-coating formulations and as a modifier for epoxy-resin surface coatings (IARC 1985).

Coal tar pitch is primarily used as the binder for aluminum smelting electrodes (IARC 1984). Pitches are also used in roofing materials, surface coatings, black varnishes, and pipe-coating enamels. Coal tar pitch is used to impregnate and strengthen the walls of brick refractories. Hard pitch is used as a binder for foundry cores. Coke oven pitch is used to produce pitch coke, which is subsequently used as the carbon component of electrodes, carbon brushes, and carbon and graphite articles. Distillation fractions and residues from high-temperature coal tars are used in the production of naphthalene, recovery of benzene, production of anthracene paste, briquetting of smokeless solid fuel, impregnation of electrodes and fibers, manufacture of electrodes and graphite, and for road paving and construction (IARC 1985).

## PRODUCTION

Coal tar was first produced in the United States in 1913, when over 1.0 billion lb were produced as a by-product of coke production (IARC 1985). The majority of coal tar production occurs in the steel industry, and therefore, its production depends on the demand for steel. U.S. production was 168.6 and 188.5 million gallons in 1986 and 1987, respectively (ATSDR 1996). In 1994, the annual U.S. production was 1.8 billion lb (USITC 1995). Six current U.S. suppliers of coal tar and one supplier of coal tar pitch were identified (Chem Sources 2001).

## EXPOSURE

The primary routes of potential human exposure to coal tar and coal tar products are inhalation, ingestion, and dermal contact. Occupational exposure of workers to coal tars and pitch may occur during coke production, coal gasification, aluminum production, and at foundries. NIOSH estimated that 145,000 workers were employed in operations that involve coal tar products. OSHA reported that approximately 10,000 coke oven workers were potentially exposed to coal tar in the workplace (IARC 1984). NIOSH reported pitch volatile concentrations (benzene soluble fraction) ranging from 0.4 to 12.0 $mg/m^3$ as an 8-hr time-weighted average (TWA) at three aluminum production facilities. NIOSH estimated that all workers at these facilities were potentially exposed to pitch volatiles at a concentration of 3.4 $mg/m^3$ as an 8-hr TWA (NIOSH 1974). Workers in the coal gasification industry and iron and steel foundry industry are also potentially exposed to pitch volatiles including a variety of polycyclic aromatic hydrocarbons (IARC 1984). OSHA estimated that 121,000 workers were potentially exposed to tars, and approximately 2,500 workers at 50 facility locations in the U.S. were potentially exposed to coal tar pitch volatiles (CTPVs) while coating metallic pipes with hot coal tar enamels (Larson 1978). Exposure of the general population to coal tar may occur through its use in treating skin disorders. Nearly 2% of the United States population is affected by psoriasis, one of the conditions for which coal tar ointments (containing 1% to 10% coal tar) is prescribed (IARC 1985). The general population may also be exposed to tars that are present as environmental contaminants.

Potential occupational exposure to coal tar pitch (usually measured as CTPVs) can occur for workers producing or using pavement tar, roofing tar, coal tar pitch, coal tar paints, coal tar coatings, coal tar enamels, and refractory bricks. NIOSH estimated that approximately 500,000 workers were potentially exposed to asphalt fumes while at work (NIOSH 1979a). The ambient air concentrations of polycyclic aromatic hydrocarbons near roof tarring operations ranged from 0 to 200 $\mu g/m^3$, and 0 to 3700 $\mu g/m^3$ near pavement tarring operations. Another study found that pitch workers at a U.S. roofing site inhaled up to 53 mg of benzo[*a*]pyrene in 7 hours (IARC 1985).

NIOSH reported that a felt machine operator was potentially exposed to CTPVs (cyclohexane-soluble fraction) at a concentration of 0.11 $mg/m^3$. Painters using coal tar paints at a metal products plant were potentially exposed to CTPVs at a TWA concentration of 0.48 $mg/m^3$ (NIOSH 1980). The concentration of CTPVs (benzene-soluble fraction) at a plant manufacturing a plastic pipe covering (a mixture of coal tar, bitumen, and powdered polyvinyl chloride) ranged from 0.18 to 4.41 $mg/m^3$ (NIOSH 1976). Industrial hygiene surveys conducted at eight U.S. plants that coated pipes with coal tar enamel indicated that the mean potential exposure to CTPVs in the coating operations was 1.9 $mg/m^3$. Coating operators and kettle tenders were potentially exposed to mean concentrations of 6.5 $mg/m^3$ and 2.3 $mg/m^3$, respectively (Larson 1978). CTPVs (benzene-soluble fraction) were detected at 0.03 to 3.01 $mg/m^3$ in several breathing zone and area samples during the carbon-carbon impregnation and densification processes at a United States fiber plant using coal tar pitch (NIOSH 1979b). The

potential for skin exposure may be considerable for coal tar and pitch workers because they often wear little clothing due to the heat, thereby exposing large portions of the body to CTPVs. In the skin oil of nine roofing workers (potentially exposed to coal tar pitch and bitumen), 0.048 to 36 ng polycyclic aromatic hydrocarbons were detected for a 36-$cm^2$ area of the forehead (Wolff *et al.* 1982).

## REGULATIONS

EPA regulates coal tars under the Clean Air Act (CAA), setting national emission standards for point and stationary source categories. EPA also regulates tars under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Under the Resource Conservation and Recovery Act (RCRA), wastes containing tars are subject to reporting and record-keeping requirements under the hazardous waste disposal rule.

FDA requires warning labels on cosmetics containing coal tar products and has determined that coal tar shampoos are generally recognized as safe. The FDA Advisory Panel on over-the-counter drug products determined that coal tar is not safe for use as a topical antifungal agent.

NIOSH has a recommended exposure limit (REL) of 0.1 $mg/m^3$ for coal tar and coal tar pitch. NIOSH recommends a 15-minute ceiling of 5 $mg/m^3$ for asphalt fumes. OSHA has established a permissible exposure limit (PEL) of 0.2 $mg/m^3$ as an 8-hr TWA for CTPVs (benzene-soluble fraction) and 2,000 $mg/m^3$ for naphtha (petroleum distillates). OSHA also regulates tars as chemical hazards in laboratories under the Hazard Communication Standard. Regulations are summarized in Volume II, Table 48.

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